1,051,392

PATENT SPECIFICATION

DRAWINGS ATTACHED

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Int. Cl.:—B 05 c

COMPLETE SPECIFICATION

Thread Coating

We, CHAMPION SPARK PLUG COMPANY, a Corporation organised and existing under the laws of the State of Delaware, United States of America, having our principal offices at 900 Upton Avenue, Toledo, State of Ohio, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

This invention relates to an engine component such as a sparking plug having a threaded portion for engagement in a cooperatively threaded part of an internal combustion engine, and, more particularly, to such component or spark plug having a thread portion carrying a thin coating of an organo polysiloxane resin having certain physical properties and adhered to the thread portion.

Considerable difficulty has been encountered with spark plugs and other members which are threaded into parts of internal combustion engines. It has been found that an excessive torque is frequently required to remove the spark plug or the like after installation in an engine and a more or less extended period of service. Although the problem has been particularly acute in air-cooled engines, it has been found to exist with liquid-cooled engines as well.

Various attempts have heretofore been made to minimzie the torque required to remove spark plugs and the like, which frequently is substantially greater than the torque used in installation, but, so far as is known, no fully satisfactory solution to the problem has heretofore been available. In many cases, treatments which were applied proved to be of little or no benefit; in other cases, treatments that have been suggested have proved to be undesirable, sometimes fouling the entire firing end of a spark plug; and, usually, suggested treatments have fouled the plug and have been ineffective.

The present invention is based upon the discovery that an extremely thin coating of a cured organo polysiloxane resin having certain physical properties when applied to the thread portion of a spark or the like is of significant benefit at reducing the torque required for removal of the spark plug or the like from an internal combustion engine after a more or less extended period of operation.

It is an object of the invention to provide an engine component such as a spark plug or the like having a threaded portion for engagement in a cooperatively threaded opening in a part of an internal combustion engine and carrying a thin coating of an organo polysiloxane resin in a cured condition, and having certain physical properties, in particular that the average ratio of organic groups to silicon atoms is from about 1 to about 1.6.

Figure 1 is a view in vertical elevation of a spark plug, and shows, partially schematically a sprayhead for application to a thread portion of the plug of an organo polysiloxane resin coating; and

Figure 2 is a greatly enlarged, fragmentary view in section showing the thread portion of the plug of Figure 1 with the organo polysiloxane resin coating applied thereto.

Referring now, in more detail to the accompanying drawings, the spark plug of Figure 1, generally designated 10, comprises a metal shell 11, a ceramic insulator 12, and an electrode assembly generally designated 13. The electrode assembly 13 comprises a centre electrode part (not illustrated), which carries an upper stud 14 and is in electrical contact with a firing tip 15, as well as a ground electrode 16 which is in electrical contact with the metal shell 11 and forms the spark gap with the firing tip 15. The firing tip 15 and the ground electrode 16 are electrically isolated from one another by the insulator 12, and the insulator 12, together with the upper electrode part (not illustrated), the stud 14 and the firing tip 15, is suitably supported within the shell 11.

A sprayhead 17 is schematically represented in Figure 1 for application to a threaded portion 18 of the shell 11 of an organo poly-

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siloxane resin as subsequently described in more detail. It has been f und, however, that the resin can also be applied by dipping or brushing techniques.

The threaded portion 18 of the shell 11 is shown in Figure 2, on a greatly enlarged scale, with a cured, organo polysiloxane coating 19 adhered thereto.

It has been found that the organo polysiloxane resin coating 19, to be effective for minimizing the torque required to remove the spark plug 10 from an internal combustion engine after a more or less extended period of service must have a sufficient degree of integrity to be capable of substantially reducing metal-to-metal contact between the threaded portion 18 and a cooperatively threaded portion of the engine, that it must have sufficient resiliency and adherence that it is not removed by the forces involved in installation and operation, and, preferably, that it must not be appreciably decomposed at the temperatures involved in engine operation. In general, any thin, organo polysiloxane resin coating is capable of withstanding without appreciable decomposition the temperatures to which the threaded portions of spark plugs are ordinarily subjected under usual conditions of engine operation. However, many organo polysiloxane resin coatings are either too soft or too brittle to be effective at reducing metal-to-metal contact when a spark plug is installed relative to an internal combustion engine, or during service; such organo polysiloxane resins, various waxes, epoxy resins, silicone mould release materials and oils have been found to be ineffective at reducing torque required, and, in some instances, even to increase the necessary torque. Various organo polysiloxane resin coatings, however, having the requisite degree of integrity to reduce substantially metal-to-metal contact have been found to be significantly effective at reducing the torque required. Ordinarily, the molecules of organo polysiloxane resins comprise two or more chains comprising a relatively large number of —Si—O—Si— groups and what can be thought of as "cross links" between such chains. The "cross links" in the organo polysiloxane resin molecules can be formed in any of a number of ways, for example through Si — O — Si linkages, or, by any of many different mechanisms, through organic groups or nitrogen-containing organic groups. Various mechanisms by which an organo polysiloxane material having a desired level of hardness and integrity can be produced are known to skilled workers in the art. In general, when the cross-linking is through an organic group or an organic group including nitrogen, relatively long chain di-organic siloxane molecules are formed by hydrolysis and condensation in a known manner, and cross-linking is accomplished in the presence of a free radical catalyst by reaction between alkenyl, e.g. vinyl, groups and groups including a nitrogen and a hydrogen, hydrogens attached directly to silicon, organo groups which are not olefinically unsaturated, or the like. The degree of resiliency and hardness of the final, cured, organo polysiloxane resin depends upon the effective number of cross linkages, on the average, in the final composition, which, in turn, depends upon the number of alkenyl groups in the organo polysiloxane chains prior to cross-linking, relative to the average organo polysiloxane chain length. In general, however, any desired or required degree of resilience and hardness can be achieved by any one of a number of combinations of starting materials, hydrolysis conditions, and cross linkage conditions. Organo polysiloxane resins of this type are usually converted to a hardened, cured condition at temperatures somewhat above ordinary ambient temperatures, except in certain rather specialised cases where organo metallic activators are employed as free radical catalysts. Tin octoate is an example of such an organo metallic activator. In the cured, organo polysiloxane resin of this type, the average ratio of organic groups to silicon atoms is substantially 2.

A preferred family of organo polysiloxane resins for use in producing the film 19 on a spark plug or the like is one where the cross-linking is through Si — O — Si groups. Such resins are made by hydrolysis and condensation, under suitably controlled conditions, of silanes of two different types: mono-organo silanes having three hydrolyzable groups and di-organo silanes having two hydrolyzable groups. The two types of silanes are used in such proportions that the ratio of organo groups per silicon atom, on the average, is from about 1 to about 1.6. The organo groups of such organo polysiloxane resins preferably include lower alkyl groups, usually methyl, ethyl or propyl, and most desirably methyl, and may include some phenyl groups. Optimum results have been achieved with methyl polysiloxane resins, for example ones commercially available under the trade designations XR6—2122 (Dow Corning Corporation) and SR701 (General Electric Corporation). In both of these commercially available materials, the average number of methyl groups per silicon atom is 1.15. Both of these materials are air drying under ordinary ambient conditions. Excellent results have been achieved with each of these two materials, when applied as such thin layers that there is no thread interference. Excellent results can be achieved generally with coatings ranging in thickness from 0.00001 to 0.00025 inches.

Fully satisfactory results have also been achieved with another methyl polysiloxane resin, insofar as reduction in torque is concerned. Specifically, a substantially equivalent reduction in torque has been achieved using a methyl polysiloxane resin which is commercially available under the designation

XR6—1057 (Dow Corning Corporation). This material, however, requires an elevated temperature for cure, and is, therefore, less desirable than the previously identified materials.

It will be appreciated from the schematic showing of Figure 1 of the drawings hereof that some overspray onto the parts of the shell 11 other than the threaded portion 18, and even onto the firing tip 15 and the ground electrode 16 is possible. It has been found that coatings in the thickness range indicated above do not affect the sparking characteristics even though applied to the firing tip 15 and the ground electrode 16. The shell 11 of the spark plug 10 has a seat 20 which may in some instances, be a gasket seat or, in other instances, a direct seat which does not require a gasket. Application of the silicone resin coating to the seat 20 is usually advantageous, and application thereof to the portion of the plug 10 above the seat 20 is not harmful.

WHAT WE CLAIM IS:—

1. An engine component having threaded means for engagement with a cooperatively threaded opening of an internal combustion engine, and, adhered at least to the thread of said threaded means a coating of an organo polysiloxane resin, said resin being cross linked to such an extent, relative to the average chain length thereof, that the average ratio of organic groups to silicon atoms is from about 1 to about 1.6 and it is effective substantially to reduce metal-to-metal contact when the threads of said threaded means are engaged in the threaded opening of the internal combustion engine.

2. An engine component according to claim 1, which comprises a spark discharge device for igniting fuel in a combustion chamber of an internal combustion engine.

3. An engine component according t claim 1 or 2, in which said organo polysiloxane resin is cross linked through silicon-oxygen-silicon linkages.

4. An engine component according to any one of claims 1 to 3, in which the organo groups of the polysiloxane resins include, lower alkyl groups and optionally include some phenyl groups.

5. An engine component according to claim 4, in which the polysiloxane resin is a methyl polysiloxane resin.

6. An engine component according to claim 5, in which all the organo groups in the polysiloxane resin are methyl groups.

7. An engine component according to claim 5 or claim 6, which contains an average number of 1.15 methyl groups per silicon atom.

8. An engine component according to any one of claims 1 to 7, in which the said polysiloxane resin is cross linked through the organic groups.

9. An engine component according to any one of the preceding claims in which coating of the polysiloxane resin is from 0.0001 to 0.00025 inches thick.

10. A method of preparing an engine component according to any one of the preceding claims in which the said polysiloxane resin is sprayed or painted onto the said threaded means of the component or in which the said threaded means is dipped into the polysiloxane resin.

11. An engine component as hereinbefore described with reference to the drawings.

MARKS & CLERK,
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Agents for the Applicants.

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1 SHEET *This drawing is a reproducti n of the Original on a reduced scale*

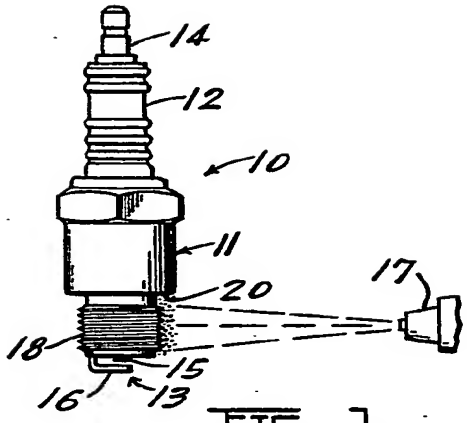

FIG-1-

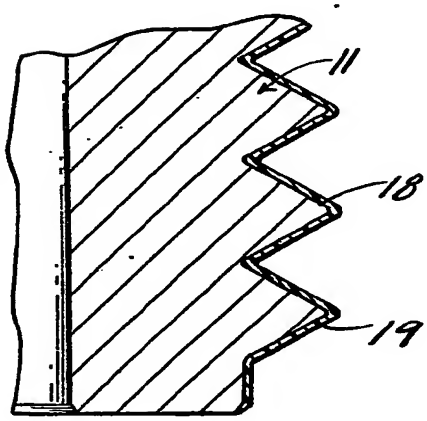

FIG-2-